PREFACE

The National Institute of Standards and Technology (NIST) initiated the federal building and fire safety investigation of the World Trade Center (WTC) disaster on August 21, 2002. This WTC Investigation, led by NIST, is being conducted under the authority of the National Construction Safety Team Act (Public Law [P.L.] 107-231).

Goals of the WTC Investigation

- To investigate the building construction, the materials used, and the technical conditions that contributed to the outcome of the WTC disaster.
- To serve as the basis for:
  - Improvements in the way buildings are designed, constructed, maintained, and used
  - Improved tools and guidance for industry and safety officials
  - Recommended revisions to current codes, standards, and practices
  - Improved public safety

Objectives of the WTC Investigation

The objectives of the NIST-led Investigation of the WTC disaster are to:

1. Determine why and how WTC 1 and WTC 2 collapsed following the initial impacts of the aircraft and why and how WTC 7 collapsed
2. Determine why the numbers of injuries and fatalities were so high or low depending on location, including technical aspects of fire protection, occupant behavior, evacuation, and emergency response
3. Determine what procedures and practices were used in the design, construction, operation, and maintenance of WTC 1, 2, and 7
4. Identify, as specifically as possible, areas in current national building and fire model codes, standards, and practices that warrant revision

Authorities and Use of Information in Legal Proceedings

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Organization of the WTC Investigation

The Investigation includes eight interdependent projects that, in combination, meet the objectives. A detailed description of each of these eight projects is available at http://wtc.nist.gov. The purpose of each project is summarized in Table P–1, and the key interdependencies among the projects are illustrated in Figure P–1.

Table P–1. Federal building and fire safety investigation of the WTC disaster.

Technical Area	Project No.	Project Purpose
Analysis of Building and Fire Codes and Practices	1	Document and analyze the code provisions, procedures, and practices used in the design, construction, operation, and maintenance of the structural, passive fire protection, and emergency access and evacuation systems of the WTC 1, 2, and 7.
Baseline Structural Performance and Aircraft Impact Damage Analysis	2	Analyze the baseline performance of WTC 1 and 2 under design, service, and abnormal loads, and aircraft impact damage on the structural, fire protection, and egress systems.
Mechanical and Metallurgical Analysis of Structural Steel	3	Determine and analyze the mechanical and metallurgical properties and quality of steel, weldments, and connections from steel recovered from WTC 1, 2, and 7.
Investigation of Active Fire-Protection Systems	4	Investigate the performance of the active fire protection systems in WTC 1, 2, and 7 and their role in fire control, emergency response, and fate of occupants and responders.
Reconstruction of Thermal and Tenability Environment	5	Reconstruct the time-evolving temperature, thermal environment, and smoke movement in WTC 1, 2, and 7 for use in evaluating the structural performance of the buildings and behavior and fate of occupants and responders.
Structural Fire Response and Collapse Analysis	6	Analyze the response of the WTC towers to fires with and without aircraft damage, the response of WTC 7 in fires, the performance of open-web steel joists, and determine the most probable structural collapse sequence for WTC 1, 2, and 7.
Occupant Behavior, Egress, and Emergency Communications	7	Analyze the behavior and fate of occupants and responders, both those who survived and those who did not, and the performance of the evacuation system.
Fire Service Technologies and Guidelines	8	Building on work done by the Fire Department of New York and McKinsey & Company, document what happened during the response by the fire services to the WTC attacks until the collapse of WTC 7; identify issues that need to be addressed in changes to practice, standards, and codes; identify alternative practices and/or technologies that may address these issues; and identify research and development needs that advance the safety of the fire service in responding to massive fires in tall buildings.

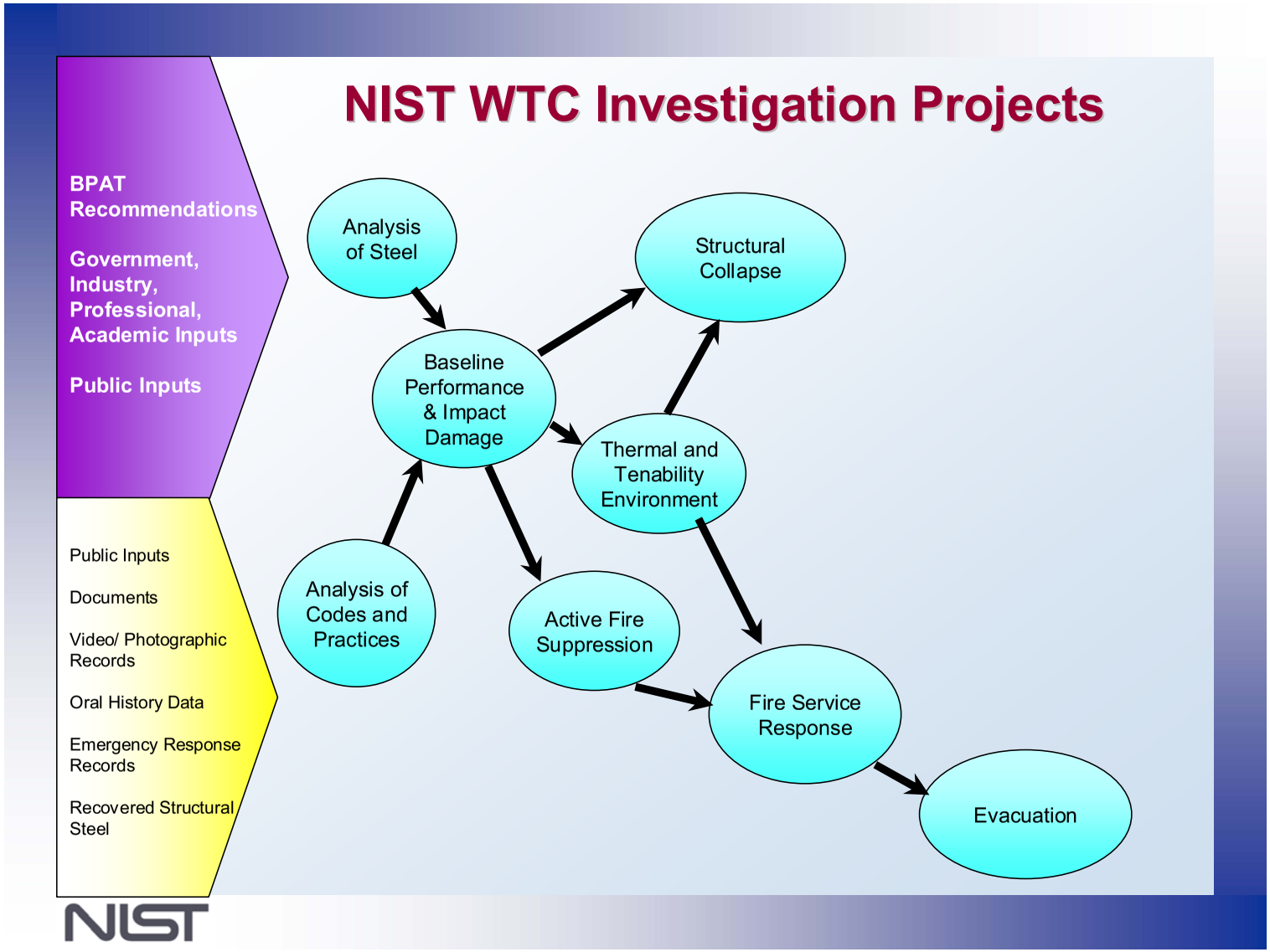

Figure P–1. The eight projects in the federal building and fire safety investigation of the WTC disaster.

NIST's WTC Public-Private Response Plan

The goal of the WTC Public-Private Response Plan is to develop the technical basis for standards, technology, and practices needed for cost-effective improvements to the safety and security of buildings and building occupants, including evacuation, emergency response procedures, and threat mitigation.

The strategy to meet this goal is a three-part NIST-led public-private response program that includes:

- A federal building and fire safety investigation to study the most probable factors that contributed to post-aircraft impact collapse of the WTC towers and the 47-story WTC 7, and the associated evacuation and emergency response experience.

- A research and development (R&D) program to provide a technical foundation that supports improvements to building and fire codes, standards, and practices that reduce the impact of extreme threats to the safety of buildings, their occupants and emergency responders.

- A dissemination and technical assistance program (DTAP) to engage leaders of the construction and building community in implementing proposed changes to practices, standards, and codes. This effort also will provide practical guidance and tools to better prepare facility owners, contractors, architects, engineers, emergency responders, and regulatory authorities to respond to future disasters.

The desired outcomes are to make all buildings safer for occupants and first responders and to ensure better evacuation systems and emergency response capabilities for future disasters.

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